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# **“Production Is Deterrence”**

Investing in Precision-Guided Weapons to Meet Peer Challengers

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## About the Authors



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## Executive Summary

**T**his report explores whether the fiscal year (FY) 2024 U.S. defense budget request for key conventional precision-guided munitions (PGMs) aligns with the 2022 *National Defense Strategy* (NDS) by prioritizing weapons needed for the “pacing challenge” China poses and dealing with the “acute threat” from Russia, while taking risk in lower priority areas. The FY24 presidential budget request builds on the shift that began in FY23 to support the NDS: increasing buys of key long-range and antiship missiles to prepare for a fight in the Pacific, starting to fill the cruise missile defense gap, bolstering production of the land-attack weapons needed in Europe, and test-running multiyear procurement and large lot procurement for key munitions to strengthen the defense industrial base.

In the Department of Defense’s (DoD) budgeting process, ships, aircraft, and vehicles tend to be prioritized, leaving missiles and munitions with inadequate funding. Moreover, the Pentagon does not take a holistic approach to procuring key conventional PGMs, making it difficult to assess the joint portfolio. If the United States is going to effectively compete with China and Russia, that needs to change.

To deter and—if deterrence fails—defeat China, the DoD needs large stockpiles of standoff missiles, maritime strike weapons, and layered air and missile defenses. The authors conclude that after years of underinvestment, the DoD is buying more long-range and medium-range missiles, which would be essential in a China war fight. While historically the Pentagon has overinvested in bombs and missiles to attack targets on the land and neglected antiship weapons, the FY24 budget saw a notable uptick in air-launched antiship weapons. For the past decade, the DoD has consistently invested in air defenses, but its purchases have focused on expensive ballistic missile defense interceptors, while neglecting cruise missile defenses. The FY24 budget reverses this trend.

Additionally, the DoD is investing in PGMs to arm Ukraine and replenish American and allied stores of weapons that are needed to counter Russia. Except for surface-to-air missiles, the weapons for Ukraine are relatively short-range land-attack PGMs that U.S. forces do not need in the Indo-Pacific. A large portion of the funding for these weapons is coming from Ukraine supplemental appropriations, not the base defense budget. Supplemental appropriations are also resourcing significant investments in U.S. production lines, but the DoD has made only moderate progress rebuilding American stockpiles of the PGMs given to Ukraine.

Ultimately, the state of the industrial base will make or break whether the United States can produce enough weapons to realize the NDS. The war in Ukraine has shed light on serious deficiencies in the United States' ability to quickly surge production of key weapons. To bolster industry, the DoD is pursuing the multiyear procurement (MYP) and large lot procurement (LLP) programs for several key PGMs. These programs will yield cost savings, but their primary benefit is strategic. MYP and LLP will strengthen the industrial base, providing industry with the stability it needs to expand production capacity. A healthy missiles-and-munitions industrial base enables the United States to counter Russia and will be a powerful deterrent to China.

Despite the progress that the FY24 budget makes in realizing the NDS by filling in critical gaps in the PGM portfolio, there remain significant shortfalls in stockpile depth and in industrial capacity. The DoD's inventory of key PGMs, especially standoff weapons, maritime strike PGMs, and air defense interceptors remains too small to blunt an initial invasion, let alone prevail in a protracted conflict against China. It will take years to rebuild American stocks to pre-2022 levels for some of the PGMs given to Ukraine. Moreover, there is a risk that these plans do not come to fruition because of service or congressional pushback against the MYP and LLP programs. More can and should be done to address these deficiencies.

For the DoD, the authors make the following recommendations:

- Make key conventional PGMs a separate reporting category and create a process that ensures a joint perspective is taken on key PGMs in each budget cycle.
- Continue to buy long-range weapons, but also develop more medium-range weapons for the pacing threat. The DoD must seek an affordable mix appropriate for different U.S. delivery platforms.

- Continue to invest in maritime strike from all domains. The Air Force should follow through on projected buys of the Long-Range Anti-Ship Missile (LRASM) and Joint Strike Missile (JSM). The Army and Marine Corps should accelerate development and procurement of weapons such as the Maritime Strike Tomahawk (MST), the SM-6, and the long-range Land-Based Anti-Ship Missile (LBASM) that increase their ability to project power in the Pacific. Likewise, the Navy should continue to buy the Mk-48 heavyweight torpedo as well as SM-6 multirole missiles.
- Continue to invest in an integrated and layered system of air defenses that includes a high-low mix that can be purchased in quantities sufficient to counter the Chinese threat. Specifically, the Army needs more of the affordable interceptors intended for air and cruise missile defense.
- Embrace MYP for key conventional PGMs to provide a consistent demand signal to industry.

For Congress, the authors make the following recommendations:

- Mandate that the DoD provides a report on key conventional PGM procurement annually and an assessment of its progress toward its stockpile requirements.
- Continue to provide supplemental appropriations to support key weapons that will be needed for Ukraine and other allies and partners, which the NDS says are a center of gravity.
- Appropriate funds for the proposed MYP and LLP programs.
- Consider making MYP for munitions a normal authority, expanding its use, and appropriating funds for these efforts.

## Introduction

**T**he war in Ukraine has reminded the world that large-scale conflicts consume enormous amounts of military equipment, especially ammunition, and has revealed weaknesses in the U.S. defense industry. As both Russia and Ukraine have relied increasingly on barrages of artillery fire and precision long-range strikes, the war has settled into a prolonged war of attrition. At peak intensity, the Ukrainians fired on average 4,000–7,000 artillery shells a day,<sup>1</sup> while the Russians more than tripled this number by launching massive bombardments of up to 20,000–30,000 shells daily.<sup>2</sup> Ammunition shortfalls have plagued both sides. Russian forces are rationing their artillery fire, using 75 percent less than their previous highs, which has hampered their 2023 offensive.<sup>3</sup> American training for Ukrainian forces has begun to emphasize how to conserve ammunition by employing fires more judiciously to enable maneuver.<sup>4</sup>

In addition to large salvos of unguided artillery, both sides have used precision-guided weapons to strike targets deep behind the front lines. Three months into the war, Russia had fired more than 2,100 cruise and ballistic missiles into Ukraine, consuming a large part of its inventory of advanced weapons.<sup>5</sup> Around the same time, the United States provided Ukraine with the High Mobility Artillery Rocket System (HIMARS) and long-range rockets, which Ukrainian forces effectively used to strike Russian ammunition depots and headquarters.<sup>6</sup>

As both combatants have depleted their stockpiles over time, they have had to adapt their tactics and acquire alternate weapons. According to one assessment, during the first 11 months of the war, Russia had fired more than 5,000 missiles and drones.<sup>7</sup> After Russia expended many of its most advanced ballistic and cruise missiles,<sup>8</sup> it increasingly relied on older weapons,<sup>9</sup> used missiles in nontraditional roles (such as air defense interceptors for ground attack),<sup>10</sup> and fired cheap Iranian loitering munitions to terrorize Ukrainian cities.<sup>11</sup> To meet the Ukrainians’ repeated demand for longer-range fires, in February 2023 the United States announced it would provide Ukraine with Ground-Launched Small Diameter Bombs (GLSDBs).<sup>12</sup> GLSDBs were an upgrade for Ukraine, with nearly double the range of the Guided Multiple Launch Rocket System (GMLRS) rounds previously provided.<sup>13</sup> In part, Washington decided to procure GLSDBs for Ukraine because it could not manufacture GMLRS fast enough, and it was not willing to dip into its stockpile of Army Tactical Missile System (ATACMS).<sup>14</sup> The GLSDB production line also had excess capacity and allowed the Department of Defense (DoD) to tap into

its plentiful stockpiles of M26 rocket motors and Small Diameter Bombs (SDB).<sup>15</sup> Since building more rocket motors has posed a challenge, utilizing existing stores of weapons and repurposing the M26 proved to be an expedient option for quickly getting additional long-range fires to Ukraine.<sup>16</sup> Similarly, since the end of the wars in the Middle East, the DoD has reduced its requirement for Joint Direct Attack Munitions (JDAMs)—the tail kits that transform dumb bombs into smart GPS-guided weapons. Unsurprisingly, the DoD added JDAMs to a security assistance package for the Ukrainian air force.<sup>17</sup>

Ukrainian forces have sought workarounds and alternate weapons in part because the U.S. defense industrial base has been unable to produce enough of the most in-demand weapons at the necessary pace. Political issues have also played a role, but, regardless, manufacturing capacity is a limiting factor with no quick solution. During the unipolar era when the United States faced no peer competitors, it scaled back weapons production and optimized for efficiency, leaving a consolidated missiles and munitions industry that today relies on complicated and fragile supply chains.<sup>18</sup> In “Precision and Posture,” a 2022 CNAS report, the authors explored how the Pentagon exacerbates this problem with volatile and inconsistent munitions buys that fail to provide industry with a regular demand signal.<sup>19</sup> As a result of these trends, the United States cannot quickly produce more weapons when needed. Supply chain issues have created bottlenecks that inhibit rapid acquisition of key components and materials, especially rocket motors, microelectronics, and energetics. To surge production, industry not only must overcome supply chain issues but also open new production lines, which requires additional machine tooling and an expanded workforce. Putting these pieces in place typically takes several years and requires substantial investment. Many defense companies are unwilling to take these steps without contracts in place to assure predictable demand. This is not simply an American problem; the European defense industrial base is in an even worse state and continues to be reliant on the United States.<sup>20</sup>

American defense companies are trying to meet the continuing demand from Ukraine, while also rebuilding U.S. and allied stocks that have been drawn down. This is in addition to building stores of the weapons that would be needed for a war against China, which the 2022 National Defense Strategy (NDS) identifies as the United States’ “pacing challenge.”<sup>21</sup> Many of the precision-guided munitions (PGMs) needed to strengthen deterrence against China differ from those that Ukraine and other allies and partners need. The DoD must meet

both important requirements simultaneously—arming European allies and partners while also procuring the right weapons for the Indo-Pacific. The president’s fiscal year (FY) 2024 budget request claims to address these problems by allocating \$30.6 billion to a category it calls “missiles and munitions” and maximizing munitions orders “that are most relevant for deterring and, if necessary, prevailing over aggression in the Indo-Pacific.”<sup>22</sup> Deputy Secretary of Defense Kathleen Hicks added that the Pentagon is “buying to the limits of the industrial base even as we are expanding those limits.”<sup>23</sup>

## **Ukrainian forces have sought workarounds and alternate weapons in part because the U.S. defense industrial base has been unable to produce enough of the most in-demand weapons at the necessary pace.**

The following analysis of the FY24 budget request assesses the Biden administration’s claims and answers the following questions: Are planned buys of key types of weapons, especially the antiship capabilities needed for the Indo-Pacific and the air defenses required for both theaters, sufficient? Can the DoD continue to arm Ukraine and rebuild U.S. stockpiles while arming for the China challenge? Has the DoD taken sufficient steps, including the use of multiyear procurement (MYP) contracts and large lot procurement (LLP), to strengthen industry?

To answer these questions, the authors build on last year’s analysis of PGM procurement, which assessed spending on a select portfolio of “key conventional PGMs.” This year’s report expands the key conventional PGM portfolio to include surface-to-air missiles and torpedoes to examine whether buys are sufficient to meet the steady state demand for air defense around the globe and the demands of future possible warfighting missions in the Indo-Pacific, such as sinking ships. Compiling DoD spending on this tailored list of critical PGMs provides a clearer picture of current joint conventional weapons capability and the ability to meet the projected warfighting demands.

The FY24 presidential budget request builds on the shift that began in FY23 to support warfighting requirements for China—the NDS’s priority challenge—by increasing buys of key long-range and antiship missiles and beginning to build out the high-low mix

of interceptors that are needed to create a layered system of air defenses. Nevertheless, current inventories of standoff weapons, maritime strike PGMs, and air defense interceptors remain far too small to blunt an initial Chinese invasion, let alone prevail in a protracted war. Largely through supplemental appropriations, the DoD is also making moderate progress in rebuilding its inventory of the seven PGMs given to Ukraine and expanding U.S. production capacity to meet the current and future demand from the United States and allies and partners. The DoD must continue to develop the PGMs that it needs to counter China, while expanding the production of existing weapons to counter Russia and refill U.S. stockpiles. It can achieve both of these objectives because, except for air defense weapons, the PGMs needed for a war in the Indo-Pacific and those needed currently in Europe differ. Finally, the Pentagon has trial MYP and LLP programs for PGMs, but the services and Congress need to embrace these initiatives, even though they limit their budgetary flexibility, to create a stable demand signal for industry. The primary benefit of MYP is strategic, not economic—it will help create a healthy missiles-and-munitions industrial base that can meet the current demand and surge when needed. Thus, Congress needs to appropriate funds for these pilot programs and support their expansion.

## **Overview of the FY 2024 Portfolio of Key Conventional PGMs**

**T**he Pentagon’s methods of reporting spending make it difficult to assess whether the DoD is buying enough of the right kinds of weapons. For FY24, the DoD reports requesting \$30.6 billion for an aggregate category of “missiles and munitions.” This blanket category lumps together funding for research, development, testing, and evaluation (RDT&E) and procurement of individual ammunition *and* conventional PGMs *and* nuclear weapons, while omitting other key weapons.<sup>24</sup> Although nuclear modernization is critical given the emerging multipolar nuclear era, these weapons do not contribute to the United States’ conventional warfighting capability.<sup>25</sup>

Last year, the authors created their own category—key conventional PGMs (see Figure 1)—to ascertain how much the DoD was requesting specifically for the conventional weapons that will be critical to deterring, and if necessary, winning a war against China or Russia. This year, the authors assessed two additional categories of precision weapons: torpedoes

and surface-to-air missiles (SAMs). Torpedoes and SAMs are critical to warfighting in the Pacific theater, but the DoD’s “missiles and munitions” category omits both. Including them is essential to evaluate the sufficiency of joint purchases of strike and air defense weapons. The U.S. military retains the advantage in undersea warfare, and attack submarines are a particularly critical warfighting capability in the Pacific theater. If China were to invade Taiwan, American submarines armed with heavy torpedoes would be one of the most effective ways of sinking ships ferrying Chinese troops.<sup>26</sup> Additionally, the war in Ukraine has driven home the importance of layered air defenses with deep magazines of SAMs to intercept enemy attacks. Air defenses have long been one of the most in-demand U.S. military capabilities across the globe. They are particularly relevant to the Indo-Pacific theater given China’s large inventory of ballistic and cruise missiles. The expanded key conventional PGM category, therefore, provides a clearer picture

of DoD investment in conventional precision-guided land-attack, air defense, and maritime strike weapons.

In a press briefing, senior DoD officials claimed that the \$30.6 billion devoted to munitions in the FY24 request was a 12 percent increase over the FY23 enacted numbers, and that compared to five years ago they were requesting “nearly 50 percent more” for munitions.<sup>28</sup> In the CNAS Defense Program’s category of key conventional PGMs (without torpedoes and SAMs), the FY24 request of \$9.324 billion represents a 33 percent increase in real dollars<sup>29</sup> over FY23 enacted but only a 22 percent increase in real dollars from five years ago. This disparity suggests that nuclear modernization accounts for a considerable amount of the DoD-reported five-year increase, which is needed and makes sense given the scale of the undertaking.<sup>30</sup> The FY24 request for this expanded PGM portfolio (adding torpedoes and SAMs) of \$12.839 billion represents a 26 percent increase over FY23 enacted.

FIGURE 1: KEY CONVENTIONAL PGM PORTFOLIO<sup>27</sup>

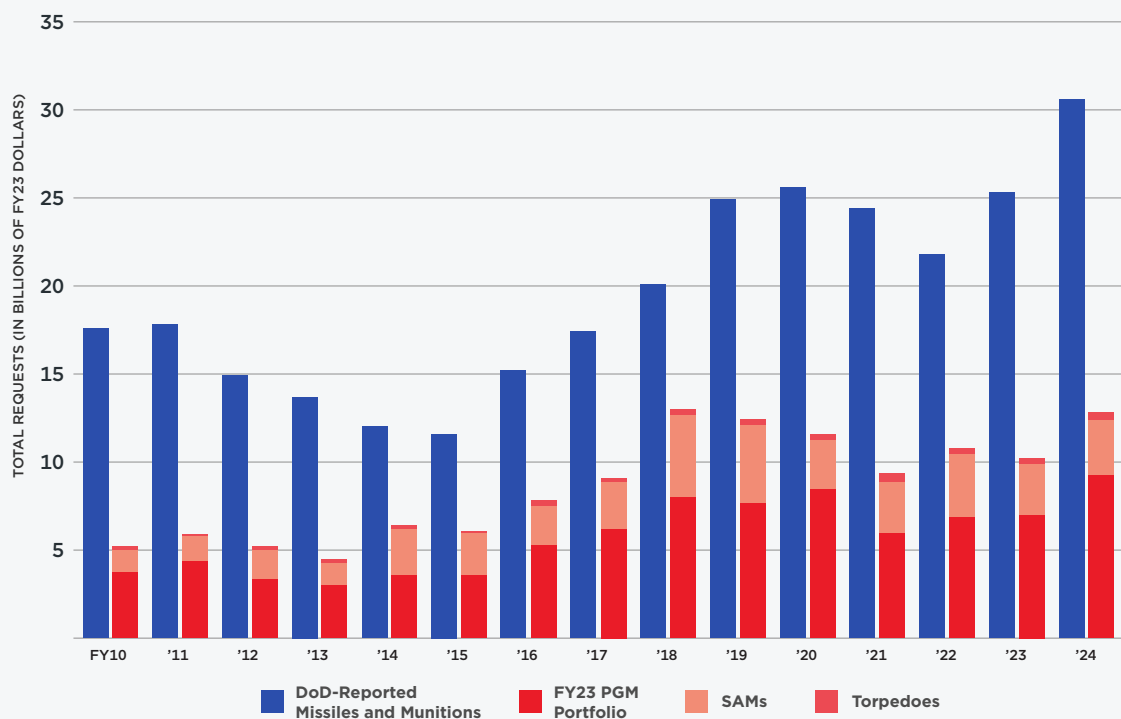
	Department of the Air Force	Department of the Navy	Department of the Army
Long (>350km)	JASSM	JASSM	PrSM
	LRASM	LRASM	SM-6* (launched with Typhon)
	ARRW*	SM-6	LRHW*
	HACM*	Tomahawk	Tomahawk* (launched with Typhon)
	HAWC/MOHAWC*	CPS	LBASM*
	TBG*	HALO*	
Medium (50-350km)	SiAW	AARGM/AARGM-ER	ATACMS
	SDB I	SDB II	GMLRS
	SDB II	JSOW	
	AIM-120 AMRAAM	NSM	
	JSM	AIM-120 AMRAAM	
	AIM-260 JATM*	GMLRS	
Short (<50km)	JDAM	JDAM	Hellfire
	Hellfire	AIM-9X Sidewinder	JAGM
	JAGM	Javelin	M-982 Excalibur
	AIM-9X Sidewinder	APKWS	C-DAEM
	APKWS		FGM-148 Javelin
SAMs		RIM-66 SM-2	AIM-9X (launched with IFPC Increment 2)
		RIM-161 SM-3	THAAD
		RIM-162 ESSM	AIM-120 AMRAAM (launched with NASAMS)
		RIM-116 RAM	PAC-3 MSE (launched with Patriot M903)
			GBI (launched with GMD)
			Tamir (launched with Iron Dome)
Torpedoes			FIM-92 Stinger MANPAD
		Mk-48 Mod 1	
		Mk-48 ADCAP heavyweight torpedo	
		Mk-54 HAAWC	

\*Not yet being procured, still in research, development, testing, and evaluation.

In 2022, CNAS researchers created a new category, key conventional PGMs, and in 2023 expanded this category to include surface-to-air missiles and torpedoes. This tailored portfolio offers a more detailed picture to complement DoD-reported spending on a larger blanket category called “missiles and munitions.”



FIGURE 2: DOD-REPORTED INVESTMENT IN “MISSILES AND MUNITIONS” VS. PROCUREMENT OF KEY CONVENTIONAL PGMS<sup>31</sup>



DoD's "missiles and munitions" investment category obfuscates spending priorities by lumping together preferred munitions with small ammunition and nuclear weapons. The authors' key conventional PGM category parses out a critical component of this larger bucket.

Parsing out key conventional precision munitions paints a clearer picture of where the United States stands in its preparation for the acute threat of Russia and pacing challenge of China. The next two sections further break down this data to assess whether the United States is buying the key PGMs it needs for China, and what resources are going toward providing Ukraine with the PGMs it needs to counter Russia. While air defenses overlap, the other requirements for these two theaters differ significantly, requiring that the DoD balance what is currently needed in Ukraine with what is needed in the future for China.

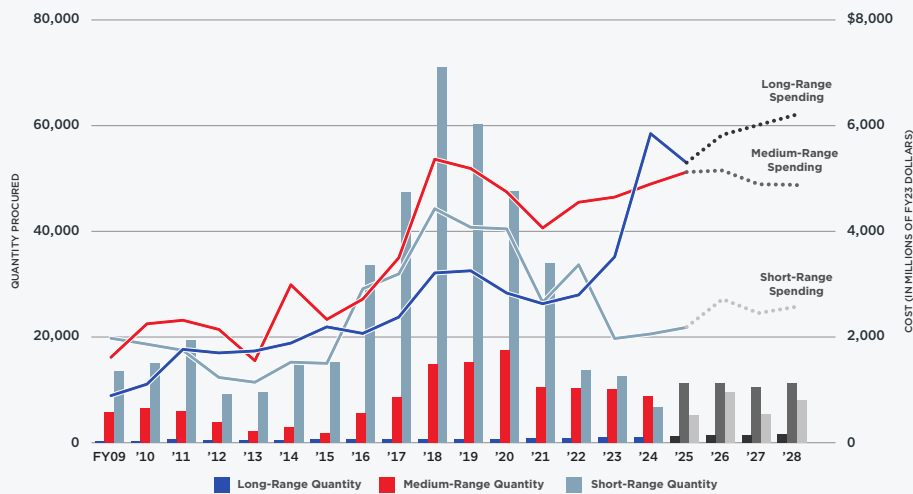
## Preparing for the Pacing Challenge

**W**hile the war in Ukraine has no end in sight, the 2022 NDS identifies China as the “pacing challenge,” and Secretary of Defense Lloyd Austin asserted that the FY24 budget is the “most strategy driven request” the DoD has ever developed.<sup>32</sup>

To assess whether that is true for the key conventional PGM portfolio, CNAS researchers examined two important characteristics of the weapons the DoD is planning to buy: their range and the mission for which they are optimized. This section also dives into specific gaps in and insufficiencies of the antiship and air defense PGM portfolios.

### From a Distance: Standoff Attack Weapons

In their analysis of the FY23 budget request, the authors identified range as a key attribute that differentiated the weapons needed to fight a peer adversary from those better suited to lesser threats.<sup>33</sup> To fight effectively against China, each service needs longer-range missiles as a part of a larger mix of weapons that can be purchased in sufficient numbers to provide U.S. forces with deep inventories to both blunt an initial attack and persevere in a protracted conflict.

**FIGURE 3: KEY CONVENTIONAL PGM PROCUREMENT BY RANGE<sup>34</sup>**

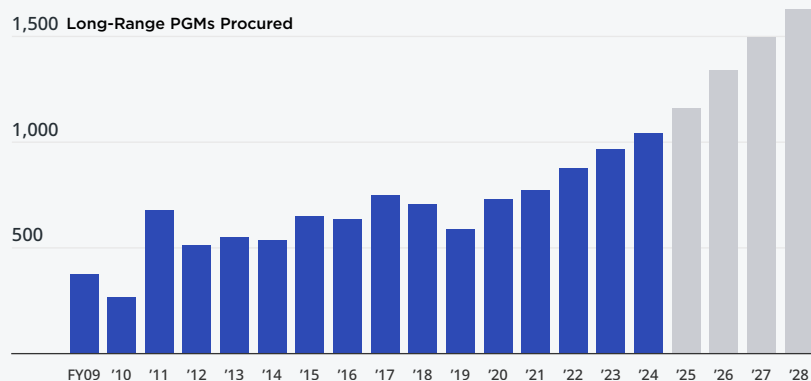
*This graph parses out spending on the expanded key conventional PGM portfolio (a category the authors created) by range. Within this category, DoD spending on medium-range weapons will surpass short-range spending for the first time in FY24, although the number of weapons requested for both medium- and short-range PGMs declined from last year.*

Despite DoD efforts to rebalance the PGM portfolio, long-range weapons quantities (as seen in Figures 3 and 4) remain below what will likely be needed to address the pacing challenge. Because of China’s air defenses, the DoD cannot simply assume that one missile will be able to destroy one target. According to open-source reports, Ukrainian SAMs have intercepted Russian long-range missiles very effectively.<sup>36</sup> Chinese air defenses will likely be able to intercept many U.S. long-range cruise missiles, especially subsonic ones. This means the DoD needs ample stockpiles of long-range missiles so it can launch large salvos to saturate China’s air defenses and increase the chance of some weapons getting through to their targets.

Because longer-range weapons are expensive and existing inventories are low, the DoD cannot afford to rely on standoff attacks alone in a conflict with China. The Pentagon also needs to invest in medium- and short-range weapons, which are cheaper and

into the medium-range category defined by the authors (50–350 kilometers), which includes the Advanced Medium-Range Air-to-Air Missile (AMRAAM), the extended range Advanced Anti-Radiation Guided Missile (AARGM-ER), and the Stand-in Attack Weapon (SiAW). The Air Force and Navy requested funds for 922 of these weapons in FY24.

Nonstealthy aircraft, like B-52 bombers or fourth-generation fighters, cannot fly into China’s dense network of sophisticated air defenses and expect to survive.<sup>38</sup>

**FIGURE 4: A CLOSER LOOK AT KEY CONVENTIONAL LONG-RANGE PGM PROCUREMENT<sup>35</sup>**

*While spending on long-range munitions shot up in FY23 (see Figure 3) and again in the FY24 request, quantities steadily increased. This steady increase in quantity is projected to continue throughout the Future Years Defense Program (FYDP).*

can be purchased in greater quantities. For the first time since 2009, the FY24 request for medium-range weapons makes up a larger portion of the key PGM portfolio than short-range weapons. Stealthy fighters also require appropriately ranged air-to-air and antiradiation missiles, so that they can take the first shot in beyond-visual-range air-to-air combat and target enemy air defense radars without flying into the heaviest defenses.<sup>37</sup> Most of these antiair and suppression-of-enemy air defense weapons fall

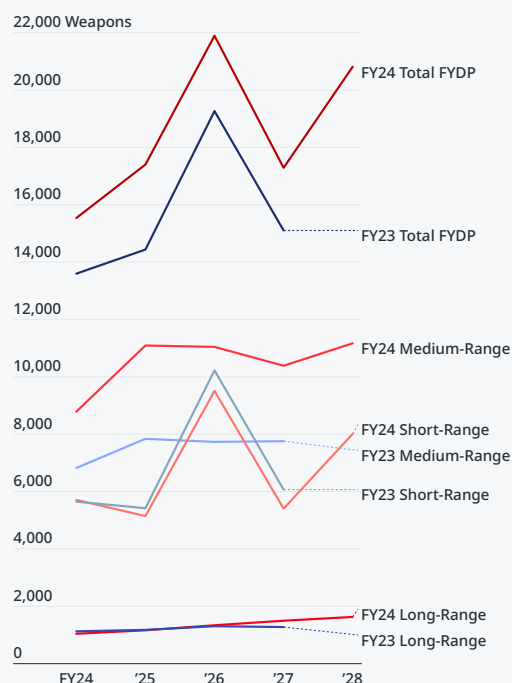
Only the B-2 and the B-21 bombers have the range and low observability to penetrate deep into heavily defended airspace. However, there are only 20 B-20 bombers, and the B-21 is not scheduled to reach initial operating capability until the mid-2020s.<sup>39</sup> To bring American airpower to a China fight, then, the Air Force needs large stockpiles of long- and medium-range cruise missiles, such as the Joint Air-to-Surface Standoff Missile (JASSM), the Long-Range Anti-Ship Missile (LRASM), and Joint Strike Missile (JSM), in addition to more long-range penetrating aircraft.<sup>40</sup> In total, the Air Force requested 625 of these three weapons this year and plans to buy 2,795 over the remainder of the Future Years Defense Program (FYDP).<sup>41</sup>

Similarly, U.S. naval ships are vulnerable to China's long-range antiship missiles. The DF-26 intermediate-range ballistic missile has a range of 3,000 kilometers and can strike ships sailing as far away as Guam.<sup>42</sup> Until China expends the bulk of its antiship ballistic missiles, many U.S. surface ships are likely to remain a great distance from China's shores, which limits their ability to conduct offensive operations unless they have long-range missiles.<sup>43</sup> In FY24, the Navy is requesting no new orders for the long-range Tomahawk but has requested to modify 50 land-attack Tomahawks into the Maritime Strike Tomahawk (MST) and to purchase 125 of the long-range multirole SM-6 missiles.<sup>44</sup> Over the remainder of the FYDP, the Navy plans to buy 153 Tomahawks and 880 SM-6 missiles.<sup>45</sup>

Finally, ground forces armed with missiles—whether they be Marine Littoral Regiments or the Army's Multi Domain Task Forces—need to be located within range of their target. Shorter-range weapons such as the Naval Strike Missile (NSM) will be useful for immediate defense and nearby sea-denial operations but cannot reach into the Taiwan Strait unless they are located on Taiwan. Longer-range weapons such as the Tomahawk cruise missile or SM-6 will allow these ground-based fires units to contribute to blunting the invasion. The Army is requesting eight Tomahawks this year and projects buying another 184 by FY28, while the Marines are procuring 34 Tomahawks this year and another 53 by FY28.<sup>46</sup> Efforts to adapt the Navy's SM-6 missile for the Army are in the works but have not yet entered into procurement.

Overall, the FY24 FYDP projects greater procurement of key conventional PGMs over the coming four years. This bump comes largely from plans for increased purchases of medium-range weapons and slight growth in long-range weapons, indicating a continuation of the strategy-driven approach that the DoD began with last year's budget.

**FIGURE 5: FY23 AND FY24 PROJECTED BUYS OF KEY CONVENTIONAL PGMs<sup>47</sup>**



*Shifting procurement projections between FY23 and FY24 may indicate shifts in procurement strategy and priorities favoring medium- and long-range weapons.*

### Mission and Mix

In addition to having weapons that can be fired from different ranges, the United States needs weapons that can perform a variety of missions: sink ships, intercept threats in the air, and hit targets on land. If the Pentagon truly focuses on China, it will invest in a different mix of PGMs tailored for the Indo-Pacific theater than it would for Europe or other persistent threats. Because China has one of the largest inventories in the world of conventionally armed cruise and ballistic missiles and a large air force, the DoD should invest heavily in weapons for air defense, both surface-to-air and air-to-air missiles, to ensure that U.S. forces can survive to defend Taiwan.<sup>48</sup> To repel an invasion of Taiwan, which is the pacing scenario,<sup>49</sup> American forces would need to sink the ships ferrying Chinese troops to Taiwan.<sup>50</sup> Stopping a Chinese invasion fleet would require the ability to deliver large numbers of heavyweight torpedoes and antiship cruise missiles in a highly contested environment. U.S. forces also need land-attack weapons to support Taiwanese ground forces or to strike Chinese air bases and ports.

FIGURE 6: KEY CONVENTIONAL PGM PORTFOLIO BY MISSION<sup>51</sup>

		Air-Launched	Ground-Launched	Surface (Ship)-Launched	Undersea-Launched
Air Defense	Long (>350km)		GBI ( <i>launched with GMD</i> ) SM-3 ( <i>launched with Aegis Ashore</i> )	SM-6 SM-3	
	Medium (50–350km)	AIM-120 (AMRAAM) AIM-260 JATM*	THAAD AIM-120 AMRAAM ( <i>launched with NASAMS</i> ) PAC-3 MSE ( <i>launched with Patriot M903</i> )	RIM-162 ESSM SM-2	
	Short (<50km)	AIM-9X Sidewinder	AIM-9X ( <i>launched with IFPC Increment 2</i> ) Tamir ( <i>launched with Iron Dome</i> ) FIM-92 Stinger	RIM-116 RAM	
Antiship	Long (>350km)	LRASM HALO*	SM-6* ( <i>launched with Typhon</i> ) LBASM*	SM-6 MST	MST
	Medium (50–350km)	JSM	NSM ( <i>launched with NMESIS</i> )	NSM	
	Short (<50km)				Mk-48 torpedo Mk-48 ADCAP heavyweight torpedo
Land-Attack	Long (>350km)	JASSM ARRW* HACM* TBG* HAWC/MOHAWC*	LRHW* Tomahawk ( <i>launched with Typhon</i> ) PrSM	Tomahawk CPS	Tomahawk CPS
	Medium (50–350km)	SDB I SDB II JSOW AARGM/AARGM-ER SiAW	ATACMS GMLRS		
	Short (<50km)	JAGM JDAM Hellfire APKWS	M-982 Excalibur C-DAEM FGM-148 Javelin		

\*Not yet being procured, still in research, development, testing, and evaluation.

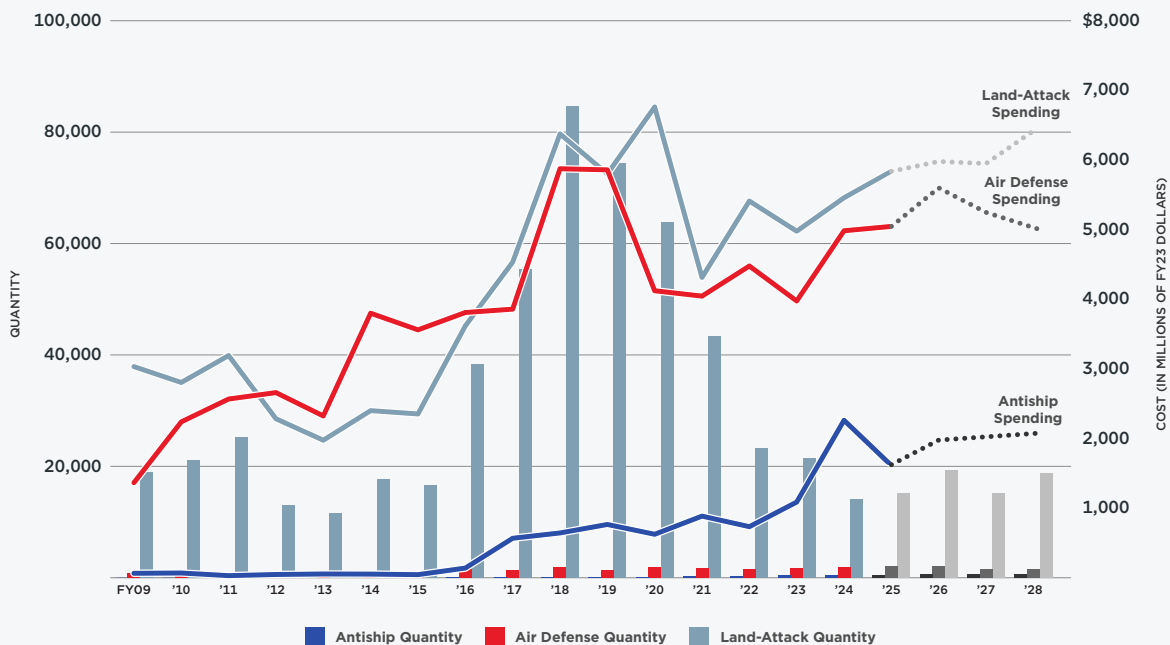
To realize joint operations, U.S. forces should be able to conduct key missions—maritime strike, air defense, land attack—from all domains and at the ranges necessitated by geography and adversary capabilities.



To determine if the DoD is buying the PGMs that would be needed in the Indo-Pacific, CNAS researchers broke down the key conventional PGM portfolio by mission and launch domain, as shown in Figure 6. One might expect each service to focus exclusively on dominating its domain. According to this logic, the Navy should buy the most antiship weapons, the Air Force air defense weapons, and the Army land-attack missiles, but the services' roles and missions have never been so clearly delineated. There have always been areas of overlap, as with the air base defense mission, a subject of intense interservice competition.<sup>52</sup> Moreover, emerging U.S. warfighting concepts, such as joint all-domain operations and joint all-domain command and control, explicitly seek to break down service and domain stovepipes on the premise that connecting all forces together, sharing information, and creating cross-domain effects will allow the United States to defeat peer adversaries.<sup>53</sup> To execute all-domain operations, American maritime, air, and land forces need weapons to conduct all key missions: sinking ships, intercepting enemy aircraft and missiles, and attacking targets on land. Simply focusing on projecting power and defeating threats in one's domain is no longer enough.

The Pentagon has overinvested in bombs and missiles to attack targets on land while neglecting antiship weapons. This means that the DoD would likely run out of antiship missiles in the first few days of a war with China.<sup>56</sup> Over the past 15 years, 96 percent of the key conventional PGMs purchased by the DoD have been land-attack weapons, while only 0.3 percent were antiship weapons. That number for antiship weapons goes up to 0.5 percent for the past five years, 1.6 percent for FY23, and 2.8 percent in the FY24 request, which is an improvement but still not enough. Moreover, because many of the existing land-attack weapons were created for the counterterrorism and counterinsurgency missions where minimizing collateral damage was paramount, they would not be effective at destroying area targets or hardened ground targets in a China fight. Although air defense weapons only comprised on average 3.4 percent of the overall inventory purchased in the past 15 years, these missiles are expensive and constituted 45 percent of the key conventional PGM budget during that same period.

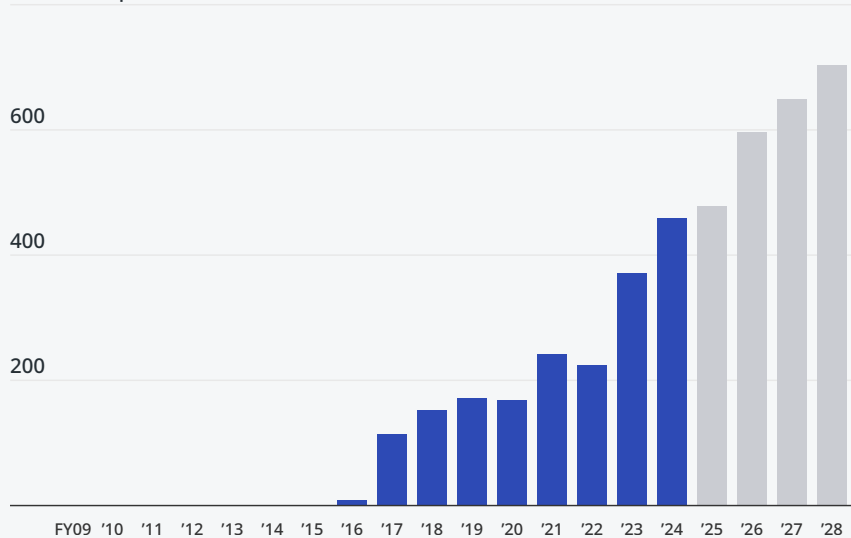
FIGURE 7: PGM PROCUREMENT BY MISSION<sup>54</sup>



*In the last 15 years, air defense and land-attack weapons consistently received the most attention. While the DoD began procuring fewer land-attack weapons since FY20, they still make up the largest portion of the PGM portfolio.*

**FIGURE 8: A CLOSER LOOK AT ANTISHIP PGM PROCUREMENT<sup>55</sup>**

800 Antiship PGMs Procured



*Antiship weapons have consistently received the least investment even after the “pivot to Asia” (see Figure 7). This trend began to shift in FY17 when the Navy began producing new torpedoes, the Air Force and Navy began procuring the LRASM, and the SM-6 was adapted for antiship missions.*

*Note: Since FY17, SM-6 missiles procured could be counted toward the antiship mission or the air defense mission. To avoid double counting, the authors made a simplifying assumption and divided SM-6 procurement quantity and spending in half between the two missions starting in FY17.*

In 2009, these procurement patterns aligned with the U.S. strategy, which was focused on countering violent extremist organizations and regional challengers that did not have large navies. Because of a growing concern about Iran and North Korea’s growing stockpiles of accurate long-range missiles, the Pentagon increasingly invested in air defense weapons.<sup>57</sup> Since 2018, however, two national defense strategies have concluded that the United States must focus on great-power competition and that China poses the greatest military challenge followed by Russia. Altering the mix of PGMs to deal with the priority challenge has lagged behind the strategy,<sup>58</sup> but there are promising signs that the DoD is building layered air and missile defenses and increasingly concentrating on the maritime strike mission.

#### AIR AND MISSILE DEFENSE MISSION

For decades, U.S. forces “enjoyed almost total control of the air.”<sup>59</sup> Consequently most American operational concepts assume U.S. air superiority. In the immediate post–Cold War era of nigh-total U.S. military dominance, U.S. forces had the freedom to operate without worrying about attacks from the air.<sup>60</sup> Over the past few decades,

threats from the air have evolved, grown, and proliferated. Iran, Russia, and North Korea have acquired increasingly capable ballistic and cruise missiles.<sup>61</sup> China has gone further, building a modern military with long-range air and missile attacks as the cornerstone of its counterintervention strategy.<sup>62</sup> In addition to modernizing the People’s Liberation Army (PLA) Air Force and arming its fighters with long-range air-to-air missiles, China has also amassed large stockpiles of sophisticated ballistic and cruise missiles that could be used to attack U.S. forces and bases within 4,000 kilometers of China’s coastline.<sup>63</sup> The Pentagon only recently began to field a layered and integrated system of air and missile defenses capable of providing U.S. forces the protection they need from Chinese air and missile attacks. Yet significant shortfalls remain in American air defense capacity and capability.<sup>64</sup> As the DoD rebuilds its air and

missile defenses, it must find the right mix of both the pricier high-end systems capable of intercepting ballistic missiles and the more affordable, less capable interceptors that can be acquired in sufficient numbers to counter complex, massed Chinese air attacks.

Modern ballistic and cruise missiles pose such a threat because of their high levels of accuracy.<sup>65</sup> Unlike earlier generations, modern missiles are likely to hit their targets and cause significant damage to U.S. forces and bases. Furthermore, both types are difficult to intercept for different reasons. Ballistic missiles are propelled by rockets into the atmosphere where they travel at high speeds on a parabolic trajectory.<sup>66</sup> More advanced ballistic missiles further complicate the picture through a range of “post-boost” maneuvers.<sup>67</sup> In contrast, cruise missiles are essentially small pilotless aircraft on a one-way strike mission.<sup>68</sup> Traditionally, they are slower moving than ballistic weapons but can fly under the radar horizon to avoid detection.<sup>69</sup> Furthermore, smart mission planners can route cruise missiles around air defenses or use terrain features, such as mountains or valleys, to hide. Regardless of missile type, they can also be fired in mass, with several missiles simultaneously approaching

a target from different directions and elevations to overwhelm air defenses.<sup>70</sup> Because of their differences, the defenses that work against ballistic missiles often are not as effective against cruise missiles and vice versa. Additionally, those defenses designed to counter ballistic missiles are much more expensive.<sup>71</sup> Ultimately, the United States needs a joint system of integrated and layered air and missile defenses that offers increased protection and a more cost-effective way of defeating air threats.<sup>72</sup>

This report divides the air defense portfolio into weapons focused on ballistic missile defense and those focused on defending against aircraft and cruise missiles.<sup>73</sup> Although spending on air defense weapons has more than tripled since 2009, the DoD has focused disproportionately on defeating ballistic missiles, while it has been slow to react to the growing threat posed by cruise missiles and fighters armed with long-range air-to-air missiles.<sup>74</sup> In particular, U.S. missile defenses have been built to defend against regional powers, such as Iran and North Korea, that have a relatively small number of theater ballistic missiles.<sup>75</sup> In every year between 2014 and 2023, spending on ballistic missile defense exceeded that of air and cruise missile defense. Spending on ballistic missile interceptors peaked in 2018 at \$4.388 billion, driven largely by the Navy and Army's Standard Missile 3 (SM-3), Terminal High Altitude Area Defense (THAAD), and Patriot Advanced Capability – 3 (PAC-3) Missile Segment Enhancement (MSE) buys. Despite these investments, the United States does not have enough missile defense units or sufficient stockpile of interceptors to mitigate the Chinese pacing challenge.

Since 2009, the Navy has purchased 636 SM-3 missiles and is planning to buy 240 more by FY28. The Army has 15 Patriot battalions each with four firing batteries,<sup>76</sup> and seven batteries of THAAD.<sup>77</sup> But there are simply not enough Army air defense units to meet the demand. For this reason, Army air defense battalions consistently have had a very high operational tempo.<sup>78</sup> Three Patriot battalions and two THAAD batteries are based in the Indo-Pacific, but there are insufficient missile defenses to protect all U.S. bases in the region.<sup>79</sup> Since 2009, the Army has procured 1,864 PAC-3 MSE interceptors, which are able to provide 155 load outs for Patriot launchers.<sup>80</sup> In this same period, the Army has purchased 610 THAAD interceptors and is planning to buy 170 more by 2028. This would provide 16 loadouts—a little more than two reloads for each of the seven fielded THAAD batteries.<sup>81</sup> As a point of comparison, Ukraine reportedly has fired 200 long-range air defense missiles a month against an adversary with much smaller missile inventories than China.<sup>82</sup> At that rate, the United States would run out of its current inventory of PAC-3 MSE interceptors in about nine months and THAAD interceptors in three months. In all

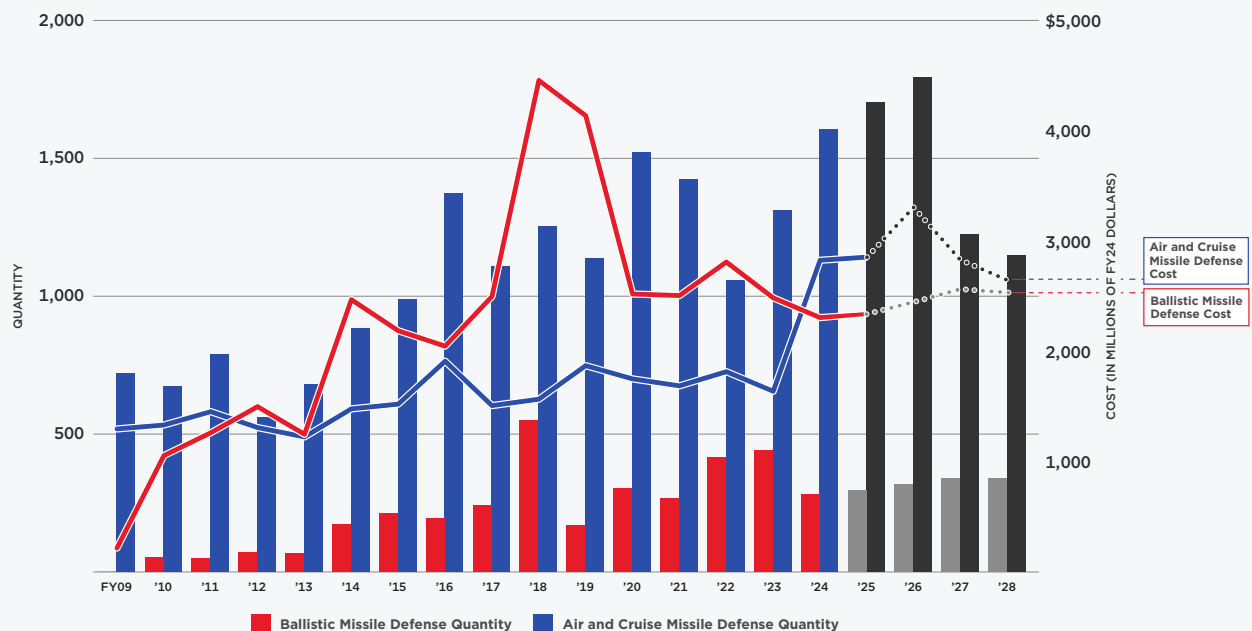
likelihood, however, the greater Chinese missile threat would deplete American SAM inventories more quickly than what has been seen in Ukraine.

FIGURE 9: U.S. AIR DEFENSE PORTFOLIO<sup>83</sup>

	Department of the Army	Department of the Navy	Department of the Air Force
<b>Ballistic Missile Defenses</b>	GBI ( <i>launched with GMD</i> ) THAAD PAC-3 MSE ( <i>launched with Patriot M903</i> )	SM-3 ( <i>ship-launched and launched with Aegis Ashore</i> )	
<b>Air and Cruise Missile Defenses</b>	AMRAAM ( <i>launched with NASAMS</i> ) AIM-9X ( <i>launched with IFPC Increment 2</i> ) Tamir ( <i>launched with Iron Dome</i> ) Stinger	SM-2 SM-6 ESSM RAM AMRAAM Sidewinder	AMRAAM Sidewinder

The authors divided the U.S. air defense portfolio by weapons intended to defend against ballistic missiles and cruise missiles to determine whether the DoD is buying the right mix to meet the pacing challenge.

In 2024, air and cruise missile defense spending will surpass ballistic missile defenses at \$2.757 billion for the first time since 2013, but air-to-air weapons will make up almost 50 percent of that total. For years, Pentagon planners ignored ground-based cruise missile defenses, assuming U.S. forces would have air superiority and that airborne early warning aircraft, battle management aircraft, and fighters armed with air-to-air missiles could detect and intercept any enemy aircraft or cruise missile attacks.<sup>85</sup> Consequently, the Air Force and the Navy have fairly consistently procured air-to-air missiles, averaging 327 AIM-120 AMRAAMs and 435 AIM-9X Sidewinders a year between 2009 and 2023 for a total of \$11.821 billion. In the FY24 budget, the Air Force and the Navy requested \$1.314 billion for 831 AMRAAMs and 339 Sidewinders. The Air Force and Navy are also developing newer longer-range air-to-air missiles aimed at defeating Chinese fighters armed with the long-range PL-15 air-to-air missiles.<sup>86</sup>

FIGURE 10: AIR DEFENSE WEAPONS PROCUREMENT<sup>84</sup>

Between 2014 and 2023, the DoD spent more on ballistic missile defense interceptors than on air and cruise missile defenses. Starting in 2024 that is projected to change.

Yet the United States needs a layered air and cruise missile defense to repel adversaries with deep inventories of missiles; that means air-to-air *and* ground-based defenses. Fighters in defensive air combat patrols provide the first line of defense, but ground-based short-range air defenses are needed for point defense and to intercept any aircraft and missiles that slip through the fighter patrol.<sup>87</sup> During the 2000s, the Army deprioritized the short-range air defense (SHORAD) mission, deactivating active-duty SHORAD battalions and removing the remaining capabilities to the National Guard.<sup>88</sup> By 2019, the Army had begun to reverse this trend, but its SHORAD units are armed with old Avenger air defense systems. Avengers have a .50 caliber gun and eight Stinger missiles, which are not capable against modern cruise missiles.<sup>89</sup>

To defend against cruise missiles and the growing threat from small drones, the Army began to develop the Indirect Fire Protection Capability (IFPC)-2 system.<sup>90</sup> After the IFPC program experienced delays, Congress forced the issue in the 2019 National Defense Authorization Act by requiring the Army to field two SHORAD batteries by 2020. In response, in 2019 the Army acquired two Israeli Iron Dome batteries as an interim short-range air defense capability, and 240 Tamir interceptors.<sup>91</sup> While Iron Dome can counter rockets, mortars, and artillery, it is not appropriate for cruise missile and air defense.<sup>92</sup> In 2020,

the Army refocused on a revised IFPC-2 design, which now is entering into procurement. For 2024, the Army requested \$313 million to procure 24 IFPC-2 Enduring Shield launchers and 66 AIM-9X interceptors.<sup>93</sup> To give the IFPC-2 more capability against higher-end threats like supersonic cruise missiles and large caliber rockets, the Army is also considering developing a second interceptor for the Enduring Shield launcher.<sup>94</sup> The Army plans to integrate IFPC batteries into its Mobile SHORAD (MSHORAD) and Patriot battalions and to connect the systems with its air and missile defense command and control architecture—the Integrated Battle Command System—which has entered into full-rate production this year.<sup>95</sup> These are important steps toward building out the layered defenses that would be needed against China.

In contrast to the Army, the Navy has continually invested in layered defenses for its Aegis cruisers and destroyers. These defenses consist of its SM-3 theater ballistic missile defenses as well as air and cruise missile defenses, the SM-2, SM-6, and SHORADs. The venerable and continually updated SM-2, still capable against a variety of advanced threats after more than 40 years in service, remains the foundation of the Navy’s air defenses.<sup>96</sup> The Navy restarted the SM-2 line in FY17 after shuttering it for eight years and in 2024 is acquiring 24 SM-2 missiles for \$89 million. The newer SM-6 is a



multimission missile that was initially designed for anti-air warfare and terminal ballistic missile defenses although it has been adapted for an antiship mission as well.<sup>97</sup> Within the air defense category, the researchers categorized the SM-6 primarily as an air and cruise missile defense weapon because it only offers local protection against ballistic missiles instead of theater-wide defenses. The Navy on average has spent \$500 million annually on SM-6 missiles for air defense between 2009 and 2023. With those funds, the Navy purchased 1,528 SM-6 missiles and is asking to buy 125 in FY24 for \$1.197 billion and another 880 through the FYDP at a cost of \$4.441 billion. Additionally, the Navy has consistently invested in its ships' inner defenses by buying the Enhanced Sea Sparrow and RAM missiles.

## **The United States needs a layered air and cruise missile defense to repel adversaries with deep inventories of missiles; that means air-to-air and ground-based defenses.**

It is challenging to assess the adequacy of the Navy's air defense missile buys because the standard loadout of its Aegis cruisers and destroyers is not public.<sup>98</sup> However, evidence suggests that the Navy is at least dissatisfied with its own stores of SM-6 missiles. At a Navy symposium in 2023, Admiral Daryl Caudle, the U.S. Navy Fleet Forces Commander, launched into a tirade against the defense industry about delivery delays for the SM-6.<sup>99</sup> Caudle stated, "I want the magazines filled, I want the ship's tubes filled," and that is not currently happening.<sup>100</sup>

China can launch large coordinated and diverse air and missile attacks against U.S. forces and bases in East Asia, overwhelming American air defenses and rapidly depleting interceptor stocks.<sup>101</sup> The United States needs a robust system of layered and integrated air defenses and deep magazines of air defense interceptors. The Army and Navy have invested in this area, but those investments are uneven and favor expensive theater ballistic missile defenses at the expense of the volume needed. The Navy does not have enough of the air defense missiles that it thinks it would need. Significant deficiencies remain in ground-based air and cruise missile defenses. The Army is beginning to address this gap, but it needs to follow through on its IFPC-2 procurement. More is needed to ensure that U.S. forces can survive to effectively conduct offensive operations, such as the maritime strike mission, that is so important in the Indo-Pacific theater.

### **MARITIME STRIKE MISSION**

At the end of the Cold War, the DoD largely walked away from the maritime strike mission because there was no enemy fleet to sink. The Navy concluded that it only needed half of the 4,000 Mk-48 heavyweight torpedoes in its inventory and canceled planned buys in 1996.<sup>102</sup> For 30 years the Navy suspended production of new heavyweight torpedoes but continued to upgrade the existing torpedoes in its stocks.<sup>103</sup> Similarly, in 1994 the Tomahawk antiship missile (TASM) was decommissioned and the cruise missiles were converted to a land-attack mode.<sup>104</sup> The medium-range Harpoon antiship missile, which entered into service in 1977, remained in service and for a period of time was the DoD's only antiship missile.<sup>105</sup>

Unsurprisingly, the Navy was the first to refocus on maritime strike. In 2016, then-Secretary of Defense Ash Carter announced that the supersonic SM-6 missile, which previously had only an air and missile defense mode, would be modified to be fired at ships.<sup>106</sup> Around the same time, the Navy restarted the production of Mk-48 heavyweight torpedoes, and in 2021, the Navy began to acquire the Maritime Strike Tomahawk (MST) to complement its multimission SM-6 missile. For FY24, the Navy requested 50 MST and plans to have purchased a total of 260 of the subsonic antiship cruise missiles by FY28. By comparison, the Navy is slowing planned buys of the midrange NSM, purchasing 13 missiles in FY24 and about the same number for each of the next four years.<sup>107</sup>

Additionally, in the last few years, the Navy and Air Force have begun to realize the need to revitalize their ability to strike ships from the air, which languished in the aftermath of the Cold War. In 2017, both services began an accelerated acquisition program for the LRASM to satisfy the urgent requirement for a new air-launched antiship weapon.<sup>108</sup> Despite realizing early operational capability of the LRASM on the B-1, the Air Force purchased few of the weapons until FY23.<sup>109</sup> In the FY24 budget request, both the Air Force and the Navy notably increase their planned LRASM buys over the next five years, resulting in a planned total stockpile of 1,321 missiles by FY28. The Air Force request remains low in FY24, but the projected requests nearly double each of the next two years from 58 missiles in FY25 to 99 missiles in FY26. In last year's budget, the Air Force planned to buy 179 LRASMs by FY27, which was clearly inadequate. This year's FYDP more than doubles the number of LRASMs that the Air Force will buy compared to last year's plan. If Congress authorizes and appropriates funds for the multiyear procurement of the LRASM, the Air Force will have purchased 488 missiles by FY28, while they Navy will have acquired 833 missiles. With this inventory, in FY28, the Air Force would be able

to launch 20 B-1 sorties armed with 24 LRASMs each.<sup>110</sup> The Navy could generate about 208 sorties of F/A-18 fighters or P-8 maritime patrol aircraft each armed with four LRASMs.<sup>111</sup>

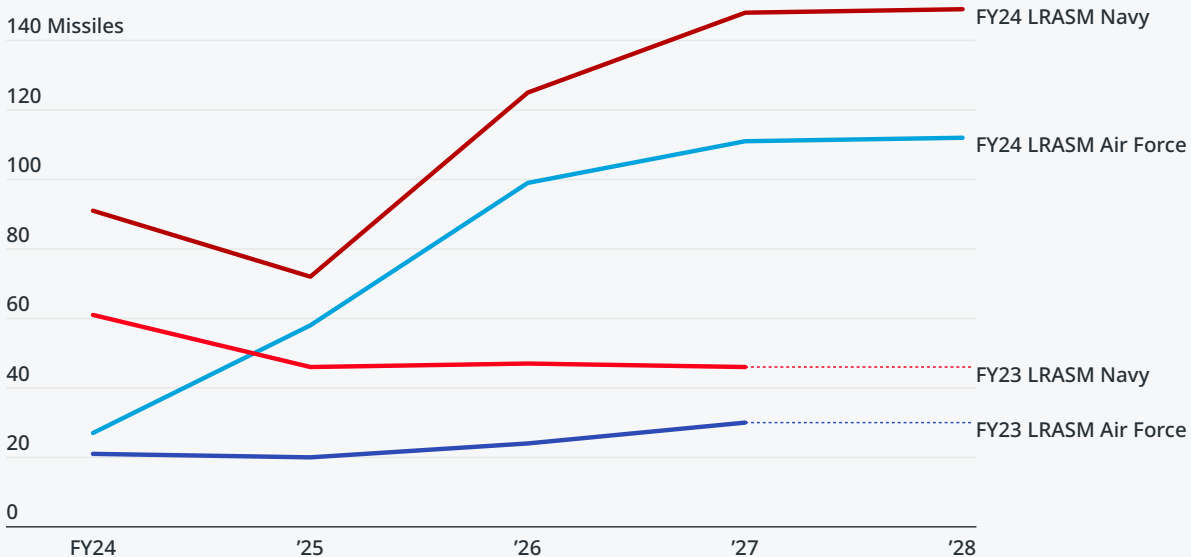
The FY24 budget also includes a new Air Force antiship missile program, the Joint Strike Missile (JSM). The JSM program modifies the NSM to fit two missiles inside of the bomb bay of the F-35, giving the Air Force a much-needed midrange antiship missile for its fighter fleet. Boeing is developing a powered version of its JDAM with a maritime seeker, which offers another potential near-term option for supplementing the air-launched antiship weapons portfolio.<sup>112</sup>

Additionally, traditional suppression weapons AARGM-ER and SiAW could supplement the maritime strike arsenal if used to target the air defense radars of Chinese destroyers and cruisers, resulting in a mission kill even if the ship is otherwise left intact. Moreover, disabling China’s maritime air defenses increases the probability that U.S. long-range antiship cruise missile strikes on China’s amphibious ships hit their mark. Without their radars, China’s air defense ships would not be able to protect the rest of the invasion fleet from incoming American missile attacks. The DoD asked to buy 91 AARGM-ERs and SiAWs in FY24 and plans to purchase another 1,042 of these supersonic weapons by FY28.

Long-range fires are critical to both the Army and the Marines, but these services requested relatively few antiship missiles in the FY24 budget. Last year, the Marines bought 115 NSMs for their Marine Littoral Regiments, and they plan on buying 90 NSMs for each of the next five years, giving them a stockpile of 565 medium-range antiship weapons by FY28. The Army plans to acquire a ground-launched version of the SM-6 and to modify the Precision Strike Missile (PrSM) to strike naval targets, but neither effort has entered into procurement yet. The 292 ground-launched Tomahawk cruise missiles that the Army and Marines plan to have bought by FY28 are land-attack variants and have no antiship capability.

While the past two years’ buys and current projections appear to signal a pivot, it is important to note that in their FY23 budget assessment, the authors found FYDP projections unreliable indicators of actual procurement quantities. Only with a sustained push throughout the next several years will the DoD be able to develop an arsenal to match its strategy. At the same time that the DoD is modernizing its PGM arsenal for the China challenge, it also must continue to arm Ukraine and European allies with older PGMs.

FIGURE 11: PROJECTED LRASM PROCUREMENT<sup>113</sup>



Both the Air Force and Navy projections for LRASM procurement have increased since 2023.

## Filling in the Blanks: Arming Ukraine and Replenishing U.S. Stockpiles

**A**lthough the NDS prioritizes China, Russia is identified as an acute threat. The United States has affirmed its commitment to opposing Russia's unprovoked aggression against Ukraine, while upholding its security commitment to NATO.<sup>114</sup> China hawks criticize the Biden administration's support for Ukraine and argue that it is coming at the expense of bolstering defenses in the Indo-Pacific region.<sup>115</sup> Because both theaters are critically important, the United States cannot myopically focus on the war in Ukraine, nor can it have a single-minded focus on a potential future war with China. The DoD must modernize its forces to counter the long-term military challenge posed by China while simultaneously using existing capabilities to support Ukraine's defense. Over the long term, the United States is looking to European allies and partners to strengthen their defenses on the eastern flank, while deepening interoperability with U.S. forces. Yet given the parlous state of European defense industry, in the near term the United States will need to help European allies replace weapons given to Ukraine so they can meet NATO's increased munitions stockpile target.<sup>116</sup> Thus, arming Ukraine and European allies with largely legacy land-attack PGMs that are not needed in the Indo-Pacific, while also building up their inventories of air defense weapons, offers a sensible approach for simultaneously dealing with both threats and managing the tradeoffs between the two regions.<sup>117</sup>

As of May 2023, the United States has provided Ukraine with \$36.9 billion in military assistance since the invasion, including large numbers of precision-guided weapons.<sup>118</sup> Many of the weapons for Ukraine come from American stockpiles through the Presidential Drawdown Authority, but the Pentagon is also increasingly procuring weapons directly using Ukraine Security Assistance Initiative (USAI) authorities through supplemental appropriations.<sup>119</sup> The Presidential Drawdown Authority allows the president to provide foreign military assistance quickly during a crisis by transferring weapons from existing U.S. stockpiles to another country. The Ukraine supplemental appropriations are also being used to rebuild supplies of weapons given to Ukraine and to expand U.S. production capacity.

Figure 12 provides an overview of the key PGMs given to Ukraine, including amounts given from U.S. stockpiles, FY23 and FY24 base budget procurement, replacement contracts funded through supplemental appropriations, and direct procurement through USAI contracts.<sup>120</sup> In

FY23, the Pentagon allocated in its base budget and through supplemental funding \$5.321 billion for seven key PGMs given to Ukraine.<sup>121</sup> Of the \$12.839 billion requested for key PGMs in the FY24 budget, only 28 percent is for these PGMs that are important to Ukraine. Fortunately, because Europe is a ground and air theater and the Indo-Pacific is an air and maritime theater, there are significant differences in the types of PGMs needed in Europe and the Indo-Pacific. Most of the PGMs given to Ukraine have been ground-launched, short-range weapons that U.S. forces would not employ in a war against China. However, these weapons may be useful to frontline partners and allies, like Taiwan, or required for U.S. forces for lesser priority threats, such as North Korea and Iran.<sup>122</sup> Air defense weapons are the exception and primary area of overlap between Ukraine and the Indo-Pacific.

**Arming Ukraine and European allies with largely legacy land-attack PGMs that are not needed in the Indo-Pacific, while also building up their inventories of air defense weapons, offers a sensible approach for simultaneously dealing with both threats and managing the tradeoffs between the two regions.**

Of the seven key PGMs provided to Ukraine, four—GMLRS, Excalibur, Javelin, and the Advanced Precision Kill Weapon System (APKWS)—are land-attack weapons. Moreover, all but GMLRS are short-range and could be only used in close contact with enemy ground forces. GMLRS is a medium-range rocket with a 70-kilometer range, which makes it less applicable to Indo-Pacific scenarios where American ground forces would likely be stationed on islands in Japan or the Philippines, hundreds if not thousands of kilometers from the Taiwan Strait.<sup>123</sup> In the base FY23 budget request, the DoD spent \$1.160 billion on these four ground attack weapons, which is a little bit less than the \$1.216 billion FY24 request. An additional \$1.469 billion in replacement contracts were issued for these ground systems, more than doubling what was spent in the FY23 base budget.<sup>124</sup> It remains to be seen whether the FY24 budget request will be bolstered by Ukraine supplementals.

The United States also has armed Ukraine with Stinger, AMRAAM, and Patriot air defense missiles. The FY24 budget request for these three missiles is \$2.39 billion, up from the \$1.733 billion in the FY23 budget request. Additionally, \$959 million has been issued in replacement contracts with 65 percent of the money going to restart the Stinger line and rebuild the Army's Stinger inventory. In total, that means the DoD spent \$2.692 billion on air defense missiles that have been given to Ukraine.

Discerning how much progress has been made on refilling U.S. stockpiles is challenging due to inconsistency of the available information. The DoD hasn't released quantities given to Ukraine for certain PGMs. Some replacement contracts indicate how many PGMs are being purchased, while others do not. Also, some of the replacement contract funding is being allocated to improving the industrial base. Figure 12 shows estimates of how many weapons the DoD would need to

purchase to replace what it has given to Ukraine.<sup>125</sup> If allocated entirely to buying weapons, already issued contracts nearly replace the quantity of GMLRS and Stinger missiles given to Ukraine but leave the DoD more than 5,000 short of both Javelins and Excaliburs. Even at a surge production rate of 400 shells a year, it would take the United States more than 15 years to replace all the Excaliburs it has given to Ukraine.<sup>126</sup> At the recently increased rate, the United States can build 2,100 Javelins a year, but the main limiting factor is the lead time for these contracts, which is nearly five years.<sup>127</sup> Because the Stinger line was essentially dormant in 2022, there is a similarly long lead time to building this legacy man-portable surface-to-air missile.

The DoD must manage the acute threat posed by Russia, while preparing for the larger China challenge. Continuing to arm Ukraine so that it can defend its territory and defeat Russia is an urgent need that the DoD

FIGURE 12: REPLENISHMENT RATES FOR KEY PGMs GIVEN TO UKRAINE

Weapon	Quantity Given to Ukraine as of May 9, 2023	FY23 Base Budget Request	Replacement Contracts <sup>128</sup>	USAI Contracts	Quantity Left to Replace	FY24 Base Budget Request	Production (2024) (Annual Rate + Lead Time)
GMLRS <sup>129</sup>	5,500 missiles	\$811 million	\$722 million (-4,300 missiles)	No	1,200 missiles	\$891 million (5,040 missiles)	Current: 14,004 Lead time: 18 months Max: 14,004 Lead time: 20 months
Javelin <sup>130</sup>	>10,000 missiles	\$186 million	\$653 million (3,100 missiles)	No	6,900 missiles	\$254 million (541 missiles)	Current/Max: 2,100 Lead time: 57 months
Stinger <sup>131</sup>	>1,600 missiles	\$0	\$624 million (1,300 missiles)	No	300 missiles	\$36 million (58 missiles)	Current: N/A Max: 720 by 2025 Lead time: 60 months
Excalibur <sup>132</sup>	>7,000 missiles	\$122 million	\$84 million >1,000 rounds	No	6,000 shells	\$39 million (107 missiles)	Current: 200 Lead time: 18 months Max: 400 Lead time: 27 months
AMRAAM <sup>133</sup>	Not publicly reported	\$671 million	\$184 million (~180 missiles)	\$2 million (~2 missiles)	Cannot determine with public information	\$1.141 billion (831 missiles)	Current: 400 Lead time: 24 months Max: 1,200 Lead time: 52 months
Patriot <sup>134</sup>	1 battery and munitions	\$1.062 billion	\$151 million <sup>135</sup> (40 interceptors)	No	Cannot determine with public information	\$1.213 billion (230 missiles)	Current/Max: 550 Lead time: 29 months
APKWS <sup>136</sup>	N/A	\$41 million	No	\$64 million (~1,600 missiles)	N/A	\$32 million (720 missiles)	Max: 25,000 Lead time: Not reported
<b>Total:</b>		\$2.893 billion	\$2.428 billion			\$3.606 billion	

This table summarizes the PGMs the United States has given Ukraine and how the United States has begun replenishing stocks and supplying Ukraine more directly.



can meet by buying more legacy land-attack weapons and air defenses. Although air defenses are in high demand in both regions, the offensive PGMs that Washington has given to Kyiv are not ones that U.S. forces need for the China challenge. Moreover, almost all the PGMs given to Ukraine have been legacy systems, including ones like HARM, RIM-7, and Harpoon that the DoD is no longer procuring and does not see a need to replace. To date, most of the funding for Ukraine PGMs has come through supplemental appropriations, which have augmented the Army's FY23 base budget by nearly a third.<sup>137</sup> The DoD also is making significant investments in the U.S. defense industrial base so that it can continue to arm

Ukraine. This will have far-reaching benefits as the United States gradually rebuilds its own stockpiles of these weapons and helps to replenish and, in some cases, augment depleted European allies' inventories. Moreover, this sudden spike in demand has the added benefit of breaking the Pentagon and U.S. defense industry out of their post-Cold War torpor and jump-starting efforts to expand American weapons production capacity for weapons that are relevant to both challenges.<sup>138</sup> Additional efforts are also needed to expand and strengthen the weapons industrial base so that it can meet the challenges of both China and Russia.

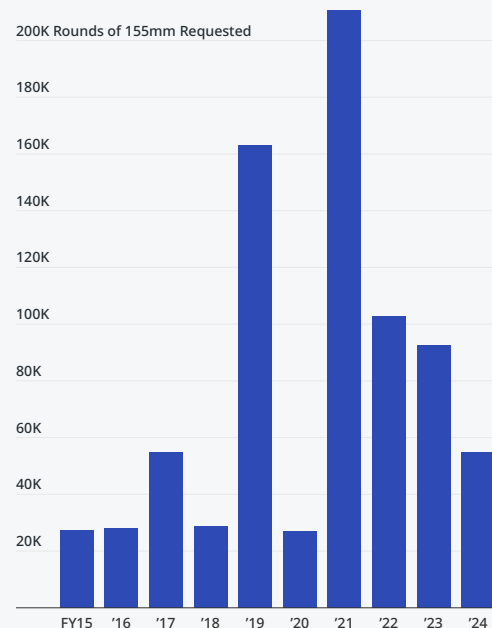
### MINI CASE STUDY: THE 155MM

One of the Ukrainian military's greatest needs is the common 155mm artillery shell—a large steel bullet filled with explosives that weighs approximately 100 pounds and is fired from a large howitzer. Because 155mm is the NATO artillery standard and thus widely available, it has been the focus of Western efforts to arm Ukraine. Ukrainian forces reportedly fire between 4,000 and 7,000 155 rounds per day<sup>139</sup> and, according to DoD officials, more than 90,000 rounds a month.<sup>140</sup> This report's analysis of key conventional PGMs does not include standard 155 rounds because they are not precision guided;<sup>141</sup> however, given their importance to the ongoing war in Ukraine, it is worth assessing the United States' ability to continue to supply Ukrainian forces with this critical ammunition.

As of May 2023, the United States has given Ukraine more than two million 155mm rounds since the invasion.<sup>142</sup> Many of these were taken from existing U.S. stockpiles using the President's Drawdown Authority. These drawdowns from U.S. supplies have included tapping into forward-deployed war reserves in places such as Israel.<sup>143</sup> Over the past 10 years, the Pentagon has asked to buy only about 790,000 155mm rounds, which suggests that the United States likely has given Ukraine more than what it has procured in 155mm purchases over the past decade.<sup>144</sup> The DoD slowed 155 procurement after meeting its acquisition objective, meaning that it had stockpiled as many 155mm rounds as it thought it needed. Most of the Army's recent 155mm purchases have been mainly for training requirements.

To avoid diminishing U.S. forces' readiness, the Pentagon has used supplemental funds to replenish American 155 stocks and also has started to procure rounds directly for Ukraine through the Ukraine Security Assistance Initiative (USAI) instead of further dipping into U.S. supplies. The \$1.39 billion in 155mm replenishment contracts provided significant investments to improve U.S. production capacity and to buy additional 155mm shells for U.S. forces.<sup>146</sup> Additionally, the DoD awarded a \$364 million USAI contract for 155mm rounds in August 2022 from domestic and international sources.<sup>147</sup> Assistant Secretary of the Army for Acquisition, Logistics, and Technology Doug Bush noted that USAI funds are

FIGURE 13: U.S. ARMY 155MM REQUESTS, FY 2015–2024<sup>145</sup>



*The Army requested a total of about 790,000 combat-capable 155mm rounds between fiscal years 2015 and 2024. The DoD has given more than two million rounds to Ukraine since February 2022.*

being used to purchase shells from international partners and that sourcing Ukraine is a “team effort.”<sup>148</sup> As no one country can meet Ukraine's 155mm needs, partners are needed, but political sensitivities can complicate resupply efforts. South Korea, for example, has refused to sell weapons directly to Ukraine. But in 2022, the United States purchased 100,000 South Korean 155mm shells to backfill its stockpiles and reportedly is seeking additional workarounds to tap into South Korea's robust defense industrial base.<sup>149</sup> In March 2023, in a historic first, the European Union announced that it was establishing a joint fund to procure one million artillery rounds for Ukraine, but the deal has been slowed over disagreements about who can sell the shells.<sup>150</sup>

The U.S. Army is also aggressively expanding its ability to produce 155mm rounds. Bush explained that this is a “new situation” because the Army needs “to both maintain our stockpile for some other contingency but also supply” Ukraine.<sup>151</sup> As of March 2023, the United States could churn out 20,000 shells per month, according to Secretary of the Army Christine Wormuth,<sup>152</sup> and is working to be able to manufacture 50,000 rounds a month by 2024<sup>153</sup> and 90,000 rounds a month by 2025.<sup>154</sup>

Currently, production of American 155mm rounds primarily occurs at four government-owned, contractor-operated facilities in the United States and each performs a different function.<sup>155</sup> This is a lean production process with multiple bottlenecks.

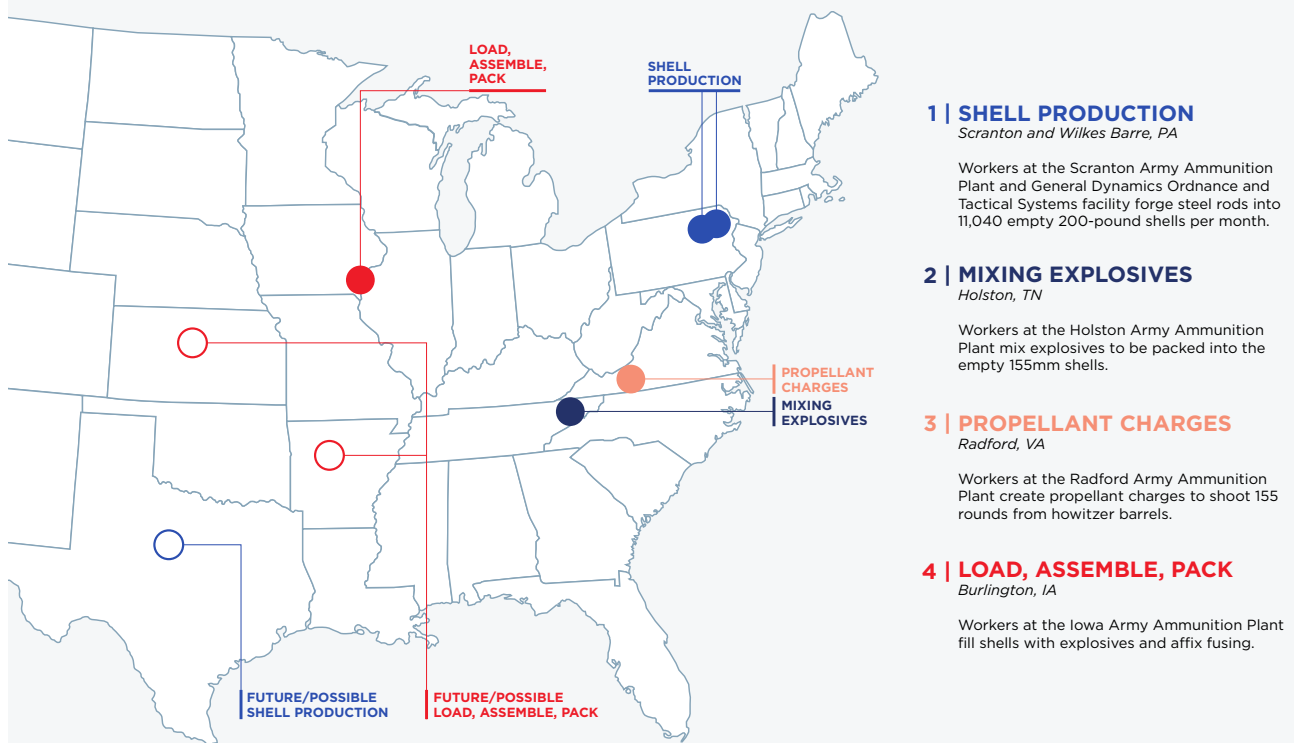
To more than triple its 155mm production capacity, the Army plans to invest \$1.45 billion in domestic industry.<sup>156</sup> Manufacturing 155mm ammunition is a heavy industrial process that requires forging solid billets of steel into shells and is constrained by what Bush has called “the long poles in the tent”: the

time it takes to acquire more machine tools.<sup>157</sup> Steel forges in Scranton and Wilkes-Barre, Pennsylvania, already have received over \$420 million for “a new building, additional equipment and improved automation.”<sup>158</sup>

The Army is also building new 155 production lines. In November 2022, contracts were awarded to expand shell production by retooling a facility in Ontario and creating a new assembly line in Texas.<sup>160</sup> New facilities for loading, assembling, and packing 155mm shells may be established in Arkansas, Iowa, and Kansas.<sup>161</sup>

These investments should allow the United States to continue supporting the Ukrainian war effort while rebuilding its own reserves and those of other allies. But purchases for the U.S. Army’s stocks appear modest. The Army only requested about 55,000 155 rounds for FY24, and the projected future buys in the FY24 budget are lower than the projected future buys in the FY23 budget.

FIGURE 14: U.S. 155MM PRODUCTION<sup>159</sup>



Domestic production of the 155mm round occurs at a small number of facilities. The U.S. Army plans to invest in new locations to begin increasing production capacity.

## Bolstering the Industrial Base

**T**he war in Ukraine has been a wake-up call for the Pentagon, raising awareness about the perilous state of the U.S. defense industrial base. According to the FY24 budget request overview, after delivering a “staggering amount of munitions” to Ukraine, “the Department has a renewed focus on securing the munitions defense industrial base and securing a stable procurement of critical munitions.”<sup>162</sup> These laudable goals mirror the authors’ recommendations from last year. But is the DoD doing enough to achieve consistent procurement?

The Pentagon launched three related efforts this year to stabilize missiles and munitions production and strengthen industry: multiyear procurement, large lot procurement, and the Joint Production Accelerator Cell (JPAC). MYP contracts are frequently used for ships and aircraft, but not often for PGMs. The 2023 National Defense Authorization Act provided the DoD with the authority to use MYP contracts for a number of critical munitions.<sup>163</sup> MYP is an alternate to annual contracts where DoD issues a contract for an item to be procured over several years, and Congress appropriates funds to implement the contract annually.<sup>164</sup> MYP saves dollars and reduces delivery delays by allowing contractors to more efficiently manage their workforce and factories, and to use advance procurement to capitalize on economies of scale by ordering greater quantities of components at a reduced price, or “economic order quantities” (EOQs).<sup>165</sup> Cost savings through MYP are often difficult to prove because cost growth can occur for reasons unrelated to the MYP.<sup>166</sup>

Yet cost savings are not the primary reason to adopt MYP for key conventional PGMs. The critical benefit of multiyear procurement is strategic rather than economic—it strengthens the missiles and munitions industrial base. MYP sends a strong signal to industry that the Pentagon is committed to procuring more of a specific PGM, which incentivizes the contractor to invest in increased production capacity. It attracts subcontractors, vendors, and suppliers. Ultimately, this results in a stronger industrial base that can produce more weapons at typical rates, while retaining an enhanced ability to surge production when needed.<sup>167</sup> As Under Secretary of Defense for Acquisition and Sustainment Bill LaPlante famously quipped, “production is deterrence.”<sup>168</sup> The United States needs the ability to produce large quantities of conventional PGMs to deter, and, if necessary, defeat China, while countering Russia. Thus, using MYP to strengthen American defense industry is an essential part of the United States’ broader strategy to compete with China.

The FY24 budget proposes MYP for seven programs: JASSM, LRASM, AMRAAM, SM-6, NSM, GMLRS, and MSE, shown in Figure 15. Six of the seven MYP weapons would be critical in a China contingency. GMLRS is less relevant for China scenarios (but central for defense of South Korea and NATO), while Patriot MSE interceptors would be an essential part of U.S. medium-range air defenses in virtually any contingency against China, Russia, North Korea, or Iran. While the Air Force has not yet provided the supplemental documentation about the projected cost savings for its three MYP contracts, Navy documents suggest that the MYP would generate nearly \$800 million in savings for its three programs alone. If Congress approves the Army’s request for MYP of GMLRS and MSE, it will yield another \$148 million in savings. In total, the DoD would save at least \$948 million, probably more than a billion dollars if Air Force cost savings were factored in.

### The war in Ukraine has been a wake-up call for the Pentagon, raising awareness about the perilous state of the U.S. defense industrial base.

In addition, in the FY24 budget request, the DoD introduced the LLP pilot program, which is “an evolution” of MYP that seeks to generate efficiencies across related programs and to take those savings to increase missile production and speed up delivery.<sup>169</sup> The pilot LLP program includes two pairs: the AMRAAM and SM-6, and the LRASM and JASSM. These weapons are paired together because they are produced at the same factory, share some parts, and have in common the original equipment manufacturer and many subcontractors. By allowing the contractor to manage the paired production lines flexibly, the LLP enables adjustments as demand between the two weapons shifts, thus reducing the risk of having excess production capacity. LLP also provides the DoD with more flexibility by permitting the same contract to be adjusted to procure upgraded variants of the weapon.

The LLP program has four components: an MYP contract, funding to expand production capacity, upfront funding for long-lead items, and expanded annual production to meet the economic production rate.<sup>170</sup> Using EOQ financing can generate cost savings that then are used to fund additional PGMs because the LLP program allows for the purchase of as many missiles as the budget can afford. Additionally, to jumpstart the LLP, the FY24 budget invests resources in a targeted fashion to alleviate choke

points in supply chains for gas turbine engines, solid rocket manufacturing, precision ball bearings, missile control actuators, and missile antennas.<sup>171</sup> For SM-6, \$269 million is devoted to expanding production capacity. Of that, \$100 million buys additional tooling and test equipment, while the remaining \$169 million in LLP funding will go toward “industrial base investments,” with the goal of expanding production from 125 to 300 missiles per year by FY28.<sup>172</sup> Similarly, the JASSM program is receiving \$77 million to expand its production capacity.<sup>173</sup> The DoD expects industry to match these investments to further expand their manufacturing capacity. Throughout the FYPD, LLP is projected to receive \$15.1 billion.<sup>174</sup>

In the spring of 2023, the Under Secretary of Defense for Acquisition and Sustainment established the JPAC to “build enduring industrial production capacity, resiliency, and surge capability for key defense weapon systems and supplies.”<sup>183</sup> The JPAC incorporated and institutionalized the Munitions Industrial Deep Dive team that was stood up after Russia’s 2022 invasion

of Ukraine and helped to accelerate the production of weapons for Ukraine.<sup>184</sup> Unlike the prior effort, which had been focused on crisis response, the JPAC is forward focused and proactively seeking to strengthen industrial base capacity, resiliency, and surge ability, and its remit has been expanded from munitions to larger weapons systems. For selected weapons, JPAC will analyze the industrial base, identify production constraints and risks, and recommend measures to alleviate the issues. In addition to improving existing industrial practices, JPAC will explore opportunities for defense industry to adopt more modern manufacturing techniques.

The Biden administration’s three efforts to strengthen the munitions industrial base with MYP, LLP, and JPAC are important steps that should be supported and expanded. Currently, MYP authorities are exceptional and only extend to a limited number of weapons. Congress should consider granting DoD a blanket authority to use MYP contracts for PGMs. Likewise, the services must avail themselves of the MYP authority to consistently purchase key PGMs, even

**FIGURE 15: MULTIYEAR PROCUREMENT AND LARGE LOT PROCUREMENT PROGRAMS IN THE FY24 BUDGET**

Weapon	Range	Mission	LLP Program	Quantity	Total Cost of Annual Contracts	Total Cost MYP	MYP Years	Estimated Savings (Over Full Term)
AMRAAM (USAF) <sup>175</sup>	Medium	Air defense	Yes (paired with SM-6)	1,710	\$1.923 billion	TBA	TBA	TBA
SM-6 (USN) <sup>176</sup>	Long	Air defense/ Antiship	Yes (paired with AMRAAM)	825	\$3.728 billion	\$3.220 billion	8	\$508 million/13.6%
LRASM (USAF) <sup>177</sup>	Long	Antiship	Yes (paired with JASSM)	407	\$1.261 billion	TBA	TBA	TBA
LRASM (USN) <sup>178</sup>	Long	Antiship	Yes (paired with JASSM)	477	\$1.508 billion	\$1.379 billion	12	\$129 million/8.6%
JASSM (USAF) <sup>179</sup>	Long	Land attack	Yes (paired with LRASM)	2,736	\$4.837 billion	TBA	TBA	TBA
NSM (USN) <sup>180</sup>	Medium	Antiship	No	516	\$1.150 billion	\$992 million	5	\$158 million/13.7%
GMLRS (USA) <sup>181</sup>	Medium	Land attack	No	27,702	\$2.666 billion	\$2.599 billion	11	\$68 million/2.5%
Patriot MSE (USA) <sup>182</sup>	Medium	Air defense	No	692	\$2.662 billion	\$2.582 billion	3	\$80 million/3p

*The DoD is seeking appropriations for MYP contracts for seven PGMs in FY24. Four of these weapons are also a part of the LLP program. MYP would not only save money, but also strengthen the industrial base by providing a stable demand for these weapons.*

*Note: Quantities listed for AMRAAM, LRASM (AF), and JASSM represent FY24 requests and projections. Prices represent expected price in FY23 dollars.*

though it limits their future flexibility. LLP is an innovative program intended to invigorate production lines for weapons that the DoD needs for an Indo-Pacific conflict. Should the pilot program succeed, the DoD should look for opportunities to expand this model, especially for critical air defense and maritime strike weapons. JPAC is likely to spearhead many of these initiatives and should ensure that the DoD remains focused on accelerating weapons production for both the near-term challenge of Russia and the long-term challenge of China.

## Conclusion

Last year, in their analysis of the FY23 budget, the authors observed the beginning of a shift in key conventional PGM buys: new programs to start filling gaps in the portfolio, initiatives to repair the broken industrial base, and momentum to shift procurement priorities to match the pacing challenge posed by China and the acute threat posed by Russia. The FY24 presidential budget request builds on that momentum: increasing buys of key long-range and antiship missiles to prepare for a fight in the Pacific, test-running multiyear procurement and large lot procurement for key munitions, and making material investment in the defense industrial base. The authors offer the following findings and recommendations to Congress and the Department of Defense to continue capitalizing on the momentum behind these hard shifts.

The war in Ukraine has demonstrated how quickly stocks of preferred munitions run dry. This has driven home the necessity of maintaining deep stockpiles that are diverse in range and delivery method. This lesson from Ukraine applies beyond Europe and is applicable to the Pacific contingency that should guide DoD planning.

**Finding:** After years of underinvestment, the DoD is buying more long-range and medium-range weapons to support the National Defense Strategy.

**Recommendation:** The DoD must continue to buy long-range weapons, but also develop more medium-range weapons for the pacing threat. It must seek an affordable mix appropriate for different U.S. delivery platforms.

The United States needs enough weapons to launch salvos from all domains in sufficient numbers to survive Chinese air attacks, exhaust and penetrate China's air defenses, and continue to project power beyond the first few days of a conflict.

**Finding:** Historically, the Pentagon has overinvested in bombs and missiles to attack targets on land while neglecting antiship weapons. The FY24 budget saw a notable uptick in air-launched antiship weapons, but more long-range and medium-range maritime strike weapons are needed.

**Recommendation:** The services should continue to invest in maritime strike from all domains. The Air Force should follow through on projected buys of LRASMs and JSMs. The Army and Marine Corps should accelerate development and procurement of weapons like the MST, the SM-6, and the Long-Range Land-Based Anti-Ship Missile (LBASM) that increase their ability to project power in the Pacific. Likewise, the Navy should continue to buy the Mk-48 heavyweight torpedo as well as SM-6 multi-role missiles.

Significant Chinese investment in aircraft and ballistic and cruise missiles enables it to launch complex large attacks against U.S. forces and bases in East Asia, overwhelming U.S. air defenses and exhausting interceptor supplies. The United States needs a more robust system of layered air and missile defenses and large stockpiles of missiles to counter this threat.

**Finding:** The DoD has invested heavily in air defense missiles over the last decade, but that investment consistently has favored expensive ballistic missile defense interceptors. In 2024, for the first time in ten years, the DoD will spend more on air and cruise missile defense interceptors than ballistic missile defenses.

**Recommendation:** The DoD needs to continue to invest in integrated and layered air defenses that include a high-low mix that can be purchased in quantities sufficient to counter the Chinese threat. Specifically, the Army needs more of the affordable interceptors intended for air and cruise missile defense.

The Department must balance the unique requirements of the Pacific theater as it continues to support allies and partners in Europe. The United States needs to replenish stocks and bolster production lines to support Ukraine and rearm U.S. forces and other frontline allies.



**Finding:** Base funding has provided only a fraction of the resources for arming Ukraine and rebuilding U.S. stockpiles. Replacement contracts added \$2.43 billion or about 24 percent to the key conventional PGM budget in FY23. With these resources, the DoD has made significant investments to expand production capacity and refill American stockpiles.

**Recommendation:** Congress should continue to provide supplemental appropriations to support key weapons that will be needed for Ukraine and other allies and partners, which the NDS says are a center of gravity. At the same time, the DoD should invest the majority of its base PGM dollars on the pacing challenge.

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Judging by the FY24 FYDP, the services are moving in the right direction, but the state of the industrial base will make or break the Pentagon’s ability to follow through on these projections. The war in Ukraine revealed how fragile the U.S. industrial base has become. This year will provide the first tests to see if new initiatives like multiyear munitions procurement and large lot procurement can shore up American industry and enable it to effectively compete against China.

**Finding:** Initial MYP and LLP programs will provide cost savings and the stability the industrial base needs to expand production for several key munitions.

**Recommendation:** To more fully realize the potential of these programs, Congress needs to appropriate the funds for proposed MYP and LLP programs.

**Recommendation:** Congress should consider making MYP for munitions a normal authority, expanding its use, and appropriating funds for these efforts.

**Recommendation:** The services also need to embrace MYP for key conventional PGMs to provide a consistent demand signal to industry.

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To be good stewards of American taxpayer dollars—to use them wisely, efficiently, and effectively—and moreover to provide for the common defense and preserve the global order, these initial steps taken by the DoD must be the beginning of a continued push for a clear, consistent munitions procurement strategy.

**Finding:** The DoD does not take a holistic approach to procuring key conventional PGMs. Each service builds its PGM budget independently as a part of its program of record, making it difficult to identify gaps and areas of overlap, or to assess cross-service trades.

**Recommendation:** The Office of the Secretary of Defense should make key conventional PGMs a separate reporting category and create a process that ensures a joint perspective is taken on key PGMs in each budget cycle.

**Recommendation:** Congress should mandate that the DoD provides a report on key conventional PGM procurement annually and an assessment of its progress toward its stockpile requirements.

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Since the “pivot to Asia” in 2012, the White House and the DoD have explicitly acknowledged the need to mentally shift and reassess how the department does business, how it organizes itself, how it trains forces, and what it buys to prepare for a growing threat. After understanding the threat and articulating a strategy, material actions should have followed. But 10 years later, the Pentagon is still wrapping its head around this immense and complex challenge, and the time to start acting has long passed. While China is the priority, at the same time the United States must oppose Russian aggression in Europe by continuing to support Ukraine. Meeting these dual threats simultaneously is challenging but can be done, especially since many of the weapons needed are different for the two theaters. It is past time for the DoD to invest in sufficient quantities of key PGMs to strengthen deterrence against China and Russia.

## Appendix: Glossary of Weapons

This appendix provides a list of U.S. missiles and munitions referenced throughout this report.

### MISSILE TYPES:

- **SAM** (Surface-to-Air Missile)
- **AGM** (Air-to-Ground Missile)
- **AIM** (Air Intercept Missile)
- **MANPAD** (Man-Portable Air-Defense System)

### MISSILES AND MUNITIONS:

- **AGM-88E AARGM** (Advanced Anti-Radiation Guided Missile) and **AGM-88G AARGM-ER** (AARGM Extended Range): air-launched antiradiation missiles.
- **AIM-120 AMRAAM** (Advanced Medium-Range Air-to-Air Missile): air-launched or ground-launched with **NASAMS** (National Advanced Surface-to-Air Missile System).
- **APKWS** (Advanced Precision Kill Weapon System): laser guidance kit for rockets, air-launched or launched by **VAMPIRE** (Vehicle-Agnostic Modular Palletized ISR Rocket Equipment) air defense system.
- **AGM-183 ARRW** (Air-Launched Rapid Response Weapon): hypersonic air-launched air-to-ground missile.
- **MGM-140 ATACMS** (Army Tactical Missile System): ground-launched land-attack missile.
- **C-DAEM** (Cannon-Delivered Area Effects Munition): ground-launched guided artillery capable of hitting mobile ground targets.
- **CPS** (Conventional Prompt Strike, formerly Prompt Global Strike [PGS]): ship- and submarine-launched boost-glide hypersonic missile.
- **RIM-162 ESSM** (Evolved SeaSparrow Missile): ship-launched anti-air missile.
- **M-982 Excalibur**: extended-range guided 155mm artillery shell.
- **GBI** (Ground-Based Midcourse Interceptor): ground-launched with **GMD** (Ground-Based Midcourse Defense).
- **GMLRS** (Guided Multiple Launch Rocket System): ground-launched land-attack rocket.
- **HACM** (Hypersonic Attack Cruise Missile): air-launched hypersonic cruise missile.
- **HALO** (Hypersonic Air-Launched Offensive Anti-Surface Warfare weapon): air-launched hypersonic antiship missile.
- **AGM-88 HARM** (high-speed anti-radiation missile): air-to-surface antiradiation missile.
- **AGM-114 Hellfire**: air-launched land-attack missile.
- **HIMARS** (High Mobility Artillery Rocket System): wheeled launcher capable of delivering ground-launched fires, including ATACMS, GMLRS, and PrSM.
- **AGM-179 JAGM** (Joint Air-to-Ground Missile): next-generation air-launched land-attack missile.
- **AGM-158 JASSM** (Joint Air-to-Surface Standoff Missile): air-launched stealthy long-range land-attack cruise missile.
- **AIM-260 JATM** (Joint Advanced Tactical Missile): next-generation air-to-air missile.
- **FGM-148 Javelin**: man-portable antitank missile.
- **JDAM** (Joint Direct Attack Munition): guidance tail kit that adds GPS guidance to air-dropped bombs.
- **JSM** (Joint Strike Missile): air-launched antiship cruise missile.
- **AGM-154 JSOW** (Joint Standoff Weapon): air-launched land-attack glide bomb.
- **LBASM** (Land-Based Anti-Ship Missile): next-generation ground-launched antiship weapon.
- **LRASM** (Long Range Anti-Ship Missile): long-range stealthy air-launched antiship missile.
- **LRHW** (Long-Range Hypersonic Weapon): ground-launched boost-glide hypersonic missile.
- **Mk-48 Mod 1**: heavyweight torpedo; and **Mk-48 ADCAP** (Advanced Capability) or **CBASS** (Advanced Capability, Common Broadband Advanced Sonar System): heavyweight torpedo.
- **Mk-54 HAAWC** (High Altitude Anti-Submarine Warfare Weapon Capability): air-launched lightweight torpedo with guidance kit.
- **MOHAWC** (More Opportunities Hypersonic Air-breathing Weapon Concept, formerly HAWC): air-launched hypersonic cruise missile.
- **MST** (Maritime Strike Tomahawk): ship- and submarine-launched subsonic antiship missile.
- **NSM** (Naval Strike Missile): ship-launched or ground-launched with **NMESIS** (Navy Marine Expeditionary Ship Interdiction System): antiship missile.
- **PAC-3 MSE** (PATRIOT Advanced Capability – 3, Missile Segment Enhancement): surface-to-air missile launched

with **PATRIOT** (Phased Array Tracking Radar to Intercept on Target) M903 air defense system.

- **PrSM** (Precision Strike Missile): ground-launched land-attack missile.
- **RIM-116 RAM** (Rolling Airframe Missile): ship-launched SHORAD.
- **SDB I** (Small Diameter Bomb) and **SDB II**: air-launched guided glide bombs; and **GLSDB** (Ground Launched SDB): ground-launched guided glide bomb.
- **SHORAD** (Short Range Air Defense) and **M-SHORAD** (Mobile SHORAD).
- **SiAW** (Stand-in Attack Weapon): air-launched missile capable of hitting radars and mobile ground targets.
- **AIM-9X Sidewinder**: air-launched air-to-air missile or ground-launched surface-to-air missile with **IFPC-2** (Indirect Fire Protection Capability, Increment 2).
- **RIM-66 SM-2** (Standard Missile-2): ship-launched medium-range air defense missile interceptor.
- **RIM-161 SM-3** (Standard Missile-3): long-range ballistic missile interceptor, ship-launched or ground-launched with Aegis Ashore.
- **SM-6** (Standard Missile-6): multimission missile that can be used for air defense and ballistic missile defense, or as an antiship missile, ship-launched or ground-launched with Typhon (as a part of the Army’s Mid-Range Capability).
- **FIM-92 Stinger** MANPAD.
- **Tamir**: ground-launched interceptor used with Iron Dome air defense system.
- **TBG** (Tactical Boost Glide): program to develop air-launched hypersonic missile that has ended.
- **THAAD** (Terminal High Altitude Area Defense): ground-based ballistic missile defense.
- **TLAM** (Tomahawk Land Attack Missile): air-, ship- and submarine-launched subsonic ground-attack cruise missile, or ground-launched with Typhon (as a part of the Army’s Mid-Range Capability).
- **155mm**: unguided shells fired by howitzer guns.

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